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ABSTRACT

The STRATOP algorithm was developed to help planners and proponents find and test effectively designed choice objects and communication strategies. Choice objects can range from complex social, scientific, military, or educational alternatives to simple economic alternatives between assortments of branded convenience goods. Two classes of measured input data are used, one cognitive and the other affective. In addition, data on brand choice are needed to fit the parameters of the choice model. The STRATOP technique and the assorted preliminary analytical methods used modest amounts of standard data and yield very extensive findings, explicitly tailored to the needs of strategists and designers. Further experience is being accomulated with the expectation that the methods will find application in a number of areas involving significant social and economic choices among competing alternatives. (Author/JG)

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STRATOP: A MODEL FOR DESIGNING EFFECTIVE PRODUCT AND COMMUNICATION STRATEGIES

by

Edgar A. Pessemier

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(Short Version)

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STRATOP: A Model for Designing Effective Product and Communication Strategies*

Edgar A. Pessemier

The discriminant analysis model has been adapted to serve as an alternative method for developing reduced-space configurations of choice objects. Related theory and applications are discussed by Pessemier and others in five related papers [8, 4, 6, 3, 7]. The first three papers cited deal with market segmentation and market structure. Large samples were used to obtain measures of brand preference and judgments about the level of each brand on a set of affectively determinant attributes. The preference measures provided a basis for market segmentation and served as input to the joint space analysis of each segment. The other input to the joint space was an orthogonalized discriminant configuration derived from attribute judgments. The structural coefficients of the configuration indicated the contribution of each attribute to consumers' perceptions of brand differences and their preferences for individual brands. In contrast to the three papers dealing with the large sample case, the last two papers cited above developed the theory and measurement methods for single-subject discriminant analysis and joint-space applications. One of these latter papers describes a limited test of the model and the other paper describes a number of methodological issues such as rotation of the space to aid interpretation. The latter paper also describes a useful model that predicts brand choice from ratio-scaled brand preference.

Building on the earlier work, the STRATOP algorithm was developed to aid planners and proponents find and test effectively designed choice objects and communication strategies. "Choice objects" can range from

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complex alternatives found in the fields of social, scientific, military or educational decision-making to simple economic alternatives found in assortments of branded convenience goods. In this paper, attention will be devoted to the objects of market choice that are subject to a firm's design and communication decisions. This degree of specificity should not detract from the reader's appreciation of the model's broad applicability.

THE MODEL

In the market context, the STRATOP model predicts the effect on brand sales and profits of changes in a product's design and/or its supporting sales and advertising programs. In accomplishing this purpose, STRATOP exploits the properties of the Phase 2 and 3 ideal-point forms of the PREFMAP joint-space model [2]. The metric version of the latter model can accept ratio-scaled brand preference and an attribute-based, orthogonalized discriminant configuration of brands.

The measurement variables and data reduction required prior to employing the strategy testing and finding features of STRATOP deserve attention. Two classes of measured input data are used, one cognitive and the other affective. In the notation employed here,

x_{ijk} = subject i's rating of brand k on affectively determinant attribute j.

$\hat{x}_{ik}$ = subject i's ratio-scaled preference for brand k. These data are typically derived from adjusted constant sum or graded paired preference judgments.

Markets can be segmented on the basis of these or other variables. Experience indicates that one productive approach is to group buyer or consumers into M market segments on the basis of their brand preferences and assign each segment a common preference profile, $\hat{x}_m$. These segments

may also be used to develop segment-specific brand configurations. Although this secondary cognitive segmentation is called for in some cases [6], purely affective segments will be the only type considered in this discussion.

In addition to the cognitive and affective measures, data on brand choice probabilities or the relative frequency of choice are needed to fit the β parameter of the choice model in (1). Several different data collection strategies could be used in parameter fitting. For simplicity, assume relative frequency of choice data have been collected from the same subjects who provided the requisite cognitive and affective data. If p_{mk} is the relative frequency with which subjects in preference segment m chose brand k, then,

$$\hat{p}_{mk} = \hat{x}^{\hat{\beta}}_{mk} \Big/ \sum_{k=1}^{K} \hat{x}^{\hat{\beta}}_{mk}. \qquad (1)$$

This model has been successfully employed by Pessemier and others in a marketing context [10, 1]. Its relation to Luce's Choice Theorem and Steven's Power Law has been noted [9] and Nakaniski has shown that β can be estimated by regression methods [5]. For a designated segment and all brands, the linear model is

$$\ln(p/p^{\circ}) = \beta \ln(\hat{x}/\hat{x}^{\circ}) + e \qquad (2)$$

where $^{\circ}$ indicates the geometric mean over k.

The required attribute data can be processed by CONFANA, a discriminant analysis routine with added features for configural manipulation and analysis. In the derived P dimensional reduced-space, brand k's centroid location is a linear function of the J element column vector of mean attribute ratings for the brand, $\underline{x}_k$. The coefficients of the function can be found in the JxP matrix of discriminant functions, $\underline{V}$. The full PxK matrix of brand centroid locations in discriminant space, $\underline{Q} = \underline{V}'\underline{\bar{X}}$, is

orthogonalized, along with the associated $\underline{V}$ and $\underline{S}$ matrices. Call the results $\underline{Q}^*$, $\underline{V}^*$ and $\underline{S}^*$. Then $\underline{S}^*$, the matrix of discriminant structure coefficients, is Varimax rotated to simple structure and the same rigid transformation is applied to $\underline{Q}^*$ and $\underline{V}^*$. The new orthogonalized and rotated matrices are $\underline{Q}^{**}$, $\underline{V}^{**}$ and $\underline{S}^{**}$. The coefficients in $\underline{S}^{**}$ are used to analyze the contribution of attributes to the formation of the cognitive space. $\underline{Q}^{**}$ is the configuration of brands used in PREFMAP. The $\underline{V}^{**}$ and $\underline{\bar{X}}$ matrices are passed to STRATOP for testing and optimizing the design of strategy alternatives. For simplicity the ** superscripts will be dropped in the following discussion.

The analysis phases of the PREFMAP joint-space model are designated by g and the stage or iterative step in any testing or optimization procedure is designated by h. The initial condition is h=1. The Phase 2 and 3 models fit squared distance from an ideal/anti-ideal point for each segment to each brand. These squared distances are linearly related to the brand affective scale values, $\bar{x}_{mk}$. The estimated affective scales, $\hat{x}(g,h)_{mk}$, developed by STRATOP are least squares fits to the ratio-scaled affective input, $\hat{x}_{mk}$. The parameters of the linear model for each segment m in Phase g analysis are $\hat{\alpha}_o(g)_m$ and $\hat{\alpha}_1(g)_m$. They are estimated by regressing the brand ideal-point distances on the brand affective scales,

$$\hat{x}_{mk} = \alpha_o(g)_m + \alpha_1(g,)_m \, d^2(g,1)_{mk} + e_{mk}. \tag{3}$$

In turn, the estimated affective value of a brand to a segment at any stage h of the STRATOP analysis can be computed from

$$\hat{x}(g,h)_{mk} = \hat{\alpha}_o(g)_m + \hat{\alpha}_1(g)_m \, d^2(g,h)_{mk} \tag{4}$$

These estimated affective scale values can be substituted in (1) to estimate the probability of purchase,

$$\hat{p}_{mk} = \hat{x}(g,h)^{\hat{\beta}}_{mk} \Big/ \sum_{k=1}^{K} \hat{x}(g,h)^{\hat{\beta}}_{mk}. \tag{5}$$

The output of PREFMAP includes the original input configuration, $\underline{Q}$, a vector of ideal point coordinates for each segment, $\underline{\rho(g)}_m$, and the reduced-space salience weights $\underline{w(1)}_m$ or $\underline{u(1)}_m$, and the linear parameters $\hat{\alpha}_o(g)_m$ and $\hat{\alpha}_1(g)_m$. The appropriate affective distance in joint-space associated with a brand location $\rho(g,h)_{kp}$ and a market segment's ideal point, $\rho(g,h)_{mk}$, can be computed from

$$d^2(2,h)_{m,k} = \sum_{p=1}^{P} w(h)_{mp} [q(h)_{kp} - \rho(h)_{mp}]^2 \qquad (6a)$$

or

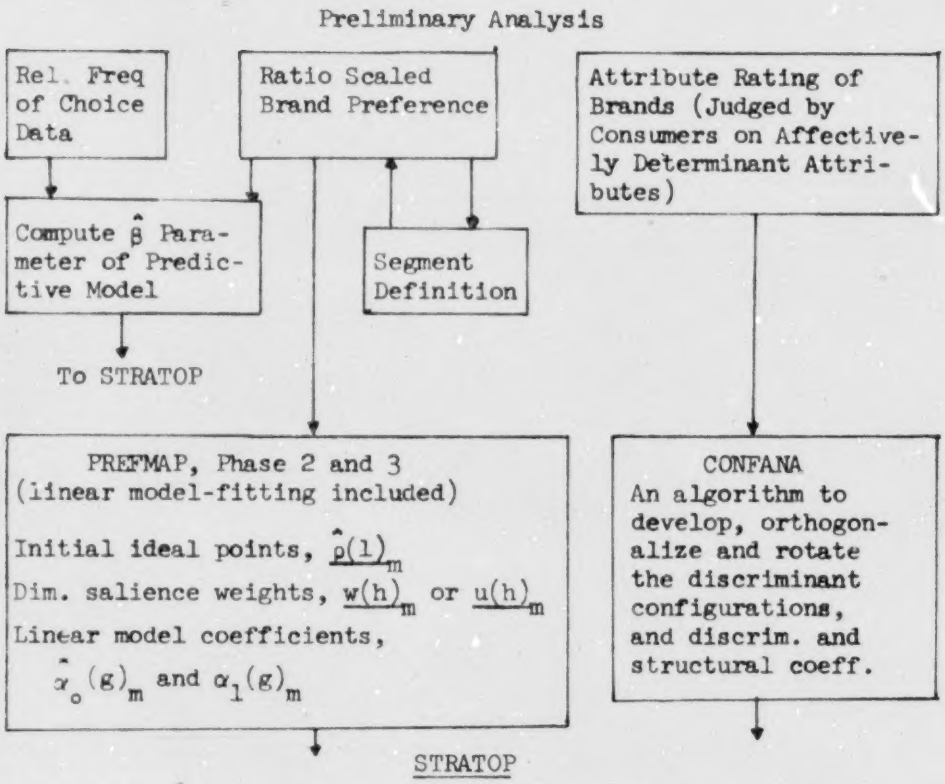
$$d^2(3,h)_{m,k} = \sum_{p=1}^{P} u(h)_{mp} [q(h)_{kp} - \rho(h)_{mp}]^2 \qquad (6b)$$

The same formulas can be used to recompute affective distance following the move of a brand or ideal point. The expected effect on choice is examined with the aid of equations (4) and (5).

The initial PREFMAP procedure and the data used for subsequent analysis are outlined in the top of Figure 1. The lower part of Figure 1 outlines the STRATOP analyses. The central features of the algorithm are briefly described below. In testing fixed or prespecified alternative strategies and in searching for improved strategies dealing with the location of a brand, ideal point or the size of an attribute salience weight, all relevant purchase probabilities are computed with the aid of equations (4) - (6). With the aid of standard accounting estimates related to revenues and costs, the expected profit implied by these probabilities are also computed. The cost of a product is $\underline{cx(h)}_k$, where $\underline{c}$ is the vector of costs per unit of each attribute and $\underline{x(h)}_k$ is the vector of attribute units in design h of product k.

A strategist may have a number of specific alternatives open when considering design and communication strategies. The more significant options

FIGURE 1


Preliminary Analysis
Rel. Freq of Choice Data
Ratio Scaled Brand Preference
Attribute Rating of Brands (Judged by Consumers on Affectively Determinant Attributes)
Compute $\hat{\beta}$ Parameter of Predictive Model
Segment Definition
To STRATOP
PREFMAP, Phase 2 and 3
(linear model-fitting included)
Initial ideal points, $\hat{p}(1)_m$
Dim. salience weights, $w(h)_m$ or $u(h)_m$
Linear model coefficients,
$\hat{\alpha}_o(g)_m$ and $\alpha_1(g)_m$
CONFANA
An algorithm to develop, orthogonalize and rotate the discriminant configurations, and discrim. and structural coeff.
STRATOP

[1] For initial input, compute $d^2(g,h)_{mk}$, $\hat{x}(g,h)_{mk}$ and $\hat{p}_{mk}$ and for all relevant cases compute expected brand unit sales, sale revenue and profits.

[2] Analyze all prespecified design, product and communication strategies. See text strategy types (1), (2), (3), (4), (5), and (6).

[3] For each location in a grid of brand locations about $q(1)$, find the most profitable position and design.

[4] For a grid of ideal-point locations about $p(1)_m$, for all M examine the revenue effects.

[5] For a grid of salience weight about $w(1)_m$ and/or $u(1)_m$, examine the revenue effects.

include:

1) A firm's or its competitor's brands may not be accurately perceived. A communication effort may correct the "errors" in brand perception by moving the brand(s) initial location, $\underline{q(1)}_k$, to a new point in space, $\underline{q(h)}_k$. Product designs remain unchanged but the effect of the communications on purchase behavior and profit must be appraised.

2) A specific design change h may be considered which will shift the location of brand k to a new estimated location $\underline{q(h)}_k$ and impose a new unit cost $\underline{cx(h)}_k$.

3) A void exists in the product space in the neighborhood of a point $\underline{q(1)}_k'$. The revenue effect of introducing a new product k' of unspecified design can be investigated. Alternatively, the profit effect of introducing a new fixed design, k", into the product space at an estimated location $\underline{q(1)}_{k"}$ may be of interest. Finally, the effect on profit of deleting a product currently at $\underline{q(1)}_k$ may be examined.

4) A strategist may want to know if the design components of product, $\underline{x(h)}_k$, can be changed to reduce the total cost of k without changing the brand's position in reduced space, $\underline{q(1)}_k$. In this case, a cost minimizing linear programming problem with (P + 2J) constraints must be solved for each $\underline{q(h)}_k$ location of interest. Fortunately, the basic solution at one stage of the design-improvement process can often be used to compute a solution at the next stage.

5) How segments appraise the importance of reduced-space attributes may work to the disadvantage of a brand, i.e. the brand may be the safest product but consumers are giving little weight to product safety. In this case, the effect of increasing the salience weighting

of safety at some communications cost becomes the subject of study.

6) The ideal level of product attributes sought by consumers may be dysfunctional, i.e. consumers want too much power or excessive levels of durability. In this case, an analyst may want to study the effect of a communication expenditure designed to relocate one or more market segment's ideal points.

In all of the above strategy testing approaches, the objective functions for a design or communication strategy h include the expected unit sales of all brands, the expected profit from the specific brand(s) of interest and the design profiles produced by cost-minimizing redesign program.

In the "optimizing" segment of STRATOP that does not employ prespecified alternative, see [3] - [5] in Figure 1, three types of search and/or optimizing are feasible. In the first case, a brand is moved plus and minus a specified increment on a dimension and its design is optimized (the cost minimized) at each new point. The brand movement is repeated for all reduced space dimensions. In the second case, ideal points are moved an increment on each dimension for all reduced space dimensions. In the third case, the salience weights for each dimension is changed by a percentage increment for all reduced space dimensions. In all three search and/or optimization runs, the objective is to locate efficient strategies for repositioning a brand's or modifying segment's utility function.

CONCLUSION

It is noteworthy that the STRATOP technique and the associated preliminary analytical methods use modest amounts of standard data and yield very extensive findings explicitly tailored to the needs of strategists and designers. Furthermore, the economics of the problem are always examined

in connection with the design and communication alternatives. The full set of procedures is too new to have faced the test of extensive applications. However, most of the programs have successfully run on large and realistic test problems. Further experience is being accumulated with the expectation that the methods will find application in a number of areas involving significant social and economic choices among competing alternatives.

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